their presence is instrumental in causing a magma to undergo a transition from a glassy state to a liquid state.

(Arguments along somewhat similar lines can be advanced for the mineralizing action of C, P, and S, but the arguments are not so straightforward as those given above for the action of the univalent negative ions.)

THE HYDRATES OF SODIUM TETRABORATE

A. O. McIntosh and F. W. Matthews,
Central Research Laboratory, Canadian Industries Limited, McMasterville, Quebec.

During an attempt to prepare the *x*-ray diffraction powder patterns of the products formed during the dehydration of borax, several features were noted which we do not believe have been reported previously.

Samples of borax ($Na_2B_4O_7 \cdot 10H_2O$) were heated to constant weight at atmospheric pressure at temperatures of 80° C., 100° C. and 200 °C. Another portion of borax was dehydrated at room temperature (approximately 25° C.) over calcium chloride desiccant. After five weeks this last sample had not reached constant weight Table 1. The products were examined by the *x*-ray diffraction powder technique.

The powder data obtained were in good agreement with the published patterns for the deca and penta hydrates (1). The composition of these hydrates was confirmed by chemical analyses of samples prepared under controlled conditions.

Table 1. Dehydration of $Na_2B_4O_7 \cdot 10H_2O$

Temperature	Loss as Moles of Water	Structure
25° C.	5.5	$Na_2B_4O_7 \cdot 10H_2O$
80° C.	6.6	$Na_2B_4O_7 \cdot 5H_2O$
100° C.	8.2	Not crystalline
200° C.	8.9	$Na_2B_4O_7 \cdot 5H_2O$

The loss of water from the decahydrate and pentahydrate of sodium tetraborate without noticeable change in the *x*-ray diffraction pattern is evidence of the presence of water loosely held in the structure. Similar behaviour is reported in the case of calcium sulphate hemihydrate (2, 5, 7) and the zeolites (3). The fact that no *x*-ray diffraction pattern was given by the product from heating at 100° C. has an important bearing on the *x*-ray identification of sodium tetraborate in commercial products.

Sodium tetraborate tetrahydrate is found in nature as the mineral kernite. It has also been synthesized (4, 6). This synthesis was repeated, borax in a sealed tube being permitted to cool slowly from 130° C. to 65° C. The *x*-ray diffraction pattern of the product was the same as that

of a sample of kernite from Kern County, California. The identity of the natural material was confirmed by optical measurements and by chemical analysis. Since to our knowledge the *x*-ray powder pattern of kernite has not been published, we are reporting it here (Table 2).

TABLE 2. X-RAY DIFFRACTION POWDER PATTERN OF KERNITE†

*d*Å	Relative Intensity	*d*Å	Relative Intensity
	I/I_1		I/I_1
7.4	1.0	2.55	0.2
6.6	0.9	2.50	0.1
6.0	0.4	2.46	0.3
4.65	0.1	2.37	0.2
4.26	0.2	2.29	0.3
3.87	0.5	2.13	0.2
3.68	0.4	2.07	0.4
3.50	0.4	1.99	0.2
3.24	0.8	1.95	0.1
3.12	0.8	1.90	0.7
2.86	0.8	1.87	0.1
2.76	0.2	1.82	0.3
2.66	0.1	1.78	0.1
2.58	0.2	1.74	0.1

† The spacings of the *x*-ray pattern of kernite are in Angstrom units, the weighted mean value of the copper Kα doublet being 1.5418Å (*Jour. Sci. Instruments*, **24**, 27, 1947).

The pattern was made with Ni filtered Cu Kα radiation using a camera of effective diameter of 14.32 cm. The camera will not record spacings greater than 16.5 Å when using copper radiation.

REFERENCES

1. American Society for Testing Materials card file of *x*-ray diffraction date.
2. FAIVRE, RENE, CHAUDRON, GEORGES, Zeolitic nature of the water in calcium sulphate hemihydrate and the effect of its removal upon the transformation of soluble anhydrite into insoluble anydrite: *Compt. rend.*, **219**, 29–30 (1944).
3. LENGYEL, B., Röntgenegraphic investigation of the crystal water in zeolites: *Zeit. Phys.*, **77**, 133–138 (1932).
4. MENZEL, HEINRICH, AND SCHULZ, HANS, Der Kernit (Rasorit) $Na_2B_4O_7 \cdot 4H_2O$: *Zeit. anorg. allgem. Chem.*, **245**, 157–220 (1940).
5. ONORATO, E., Calcium sulphate hemihydrate and soluble anhydrite: *Periodico Mineral.*, **4**, 1-42 (1933).
6. SCHALLER, WALDEMAR, T., Borate minerals from the Kramer district Mohave Desert, California: *U. S. Geol. Survey, Prof. Paper* **158**, 146–163 (1930).
7. WEISER, H. B., MILLIGAN, W. O., EPHOLM, W. C., The mechanism of the dehydration of calcium sulphate hemihydrate: *Jour. Am. Chem. Soc.*, **58**, 1261–1265 (1936).